TX

Infrared Sensor

Operating Instructions

Raytek®
A Fluke Company

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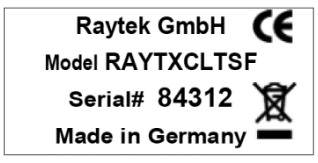
50501

Tel: (01943) 602001- WWW.ISSLTD.CO.UK - Fax: (01943) 816796



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The device complies with the requirements of the European Directives.
EC – Directive 2004/108/EC (EMC)

Conforms to relevant South Korean EMC Standards.

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NOTES

1 Safety Instructions

This document contains important information, which should be kept at all times with the instrument during its operational life. Other users of this instrument should be given these instructions with the instrument. Eventual updates to this information must be added to the original document. The instrument can only be operated by trained personnel in accordance with these instructions and local safety regulations.

Acceptable Operation

This instrument is intended only for the measurement of temperature. The instrument is appropriate for continuous use. The instrument operates reliably in demanding conditions, such as in high environmental temperatures, as long as the documented technical specifications for all instrument components are adhered to. Compliance with the operating instructions is necessary to ensure the expected results.

Unacceptable Operation

The instrument should not be used for medical diagnosis.

Replacement Parts and Accessories

Use only original parts and accessories approved by the manufacturer. The use of other products can compromise the operation safety and functionality of the instrument.

Instrument Disposal

Disposal of old instruments should be handled according to professional and environmental regulations as electronic waste.

Operating Instructions

The following symbols are used to highlight essential safety information in the operation instructions:

Helpful information regarding the optimal use of the instrument.

Warnings concerning operation to avoid instrument damage and personal injury.

Incorrect use of 110 / 230 V electrical systems can result in electrical hazards and personal injury. All instrument parts supplied with electricity must be covered to prevent physical contact and other hazards at all times.

For ATEX certified units comply with the installation and safety instructions for electrical equipment in potentially explosive atmospheres.

2 Technical Data

2.1 Models and Parameters

In general, there are two models available. The basic model (TXC, for °C, and TXF, for °F) and the Smart model (TXS).
The model descriptor is followed by the description for the optical characteristic, see following page):

Optical characteristic	LTPSF	LTSF	MTSF	G5SF (Glass)	P7SF (Plastics)	HTSF
Temperature range (°C)	- 18 to 500	- 18 to 500	200 to 1000	250 to 1650	10 to 360	500 to 2000
Temperature range (°F)	0 to 1000	0 to 1000	400 to 1800	500 to 3000	50 to 650	950 to 3600
Optical resolution (90%)	15 : 1	33 : 1	33 : 1	33 : 1	33 : 1	60 : 1
Spectral response (µm)	8 to 14	8 to 14	3.9	5.0	7.9	2.2
Close focus	CF	CF1, CF2	CF1, CF2			CF1, CF2

Thermal Parameters

Accuracy	± 1 % of reading or ± 1.4°C (2.5°F), whichever is greater (at 23°C ± 5°C (73°F ± 9°F) ambient temperature)
Repeatability	± 0.5 % of reading or ± 0.7°C, whichever is greater
Detector	Micromachined Thermopile
Response time (95 %)	165 ms (100 ms HT models)
Temperature resolution (NET)	0.1 K (LT models), 1K (all other models)
Emissivity	0.10 to 1.00 (all models)

Electrical Parameters

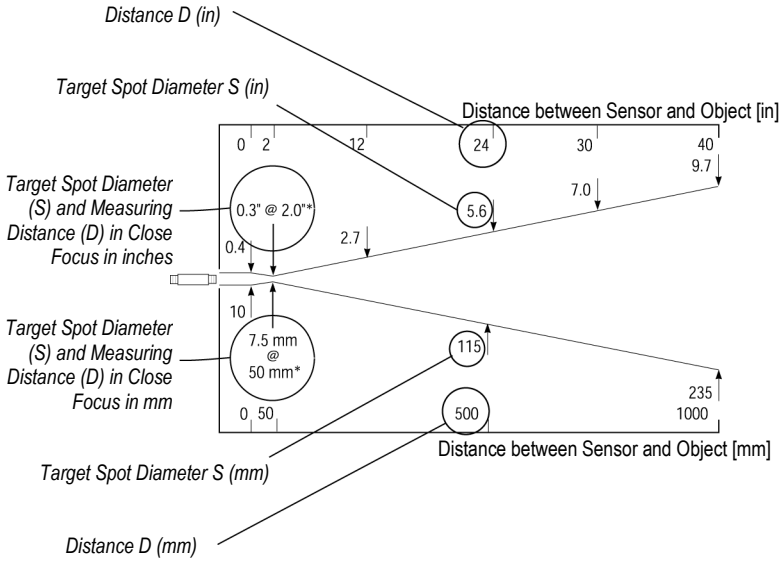
Output	4 to 20 mA
Maximum loop impedance	750 Ohm
Alarm	24 V / 150 mA (only Smart models)
Signal processing	
Smart models	°C/°F, Averaging, Peak/Valley Hold, Emissivity, internal housing temperature, external ambient temperature
Basic model	Emissivity
Power	24 VDC ± 10 %, max. 21 mA, if HART communication is required, otherwise 12 to 24 VDC +20 %

General Parameters

Environmental rating	IP 65, IEC 529, NEMA 4	
Ambient operating range	without cooling	0 to 70°C (32 to 160°F)
	with air cooling	max. 120°C (250°F)
	with water cooling	max. 175°C (350°F)
	with ThermoJacket	max. 315°C (600°F)
Storage temperature	- 18°C to 85°C (0 to 185°F)	
Relative Humidity	10% to 95% non-condensing	
Vibration	IEC 68-2-6 (MIL STD 810D), 3 axis, 11 to 200 Hz, 3 G	
Shock	IEC 68-2-27 (MIL STD 810D), 3 axis, 11 ms, 50 G	
Dimensions / Weight	Sensor	L: 187 mm; Ø: 42 mm / 330 g (Length 7.36 inches, dia 1.65 inches)
	with water cooling	L: 187 mm; Ø: 60 mm / 595 g (Length 7.36 inches, dia 2.36 inches)

2.2 Optical Diagrams

The optical diagrams indicate the target spot diameter at any given distance between the target object and the sensing head.
All target spot sizes indicated in the optical diagrams are based on 90% energy.



Close Focus D : S = *Proportion between Distance (D) to Target Spot and Target Spot Diameter (S) in Close Focus*
Far Field D : S = *Proportion with Distances 10 times greater than the Close Focus Distance*

Calculating the Target Spot Size

To calculate the target spot size from two known points within an optical diagram the following formula can be used:

$$S_x = S_n + \left[\frac{(D_x - D_n)}{(D_f - D_n)} \cdot (S_f - S_n) \right]$$

S_x = *unknown diameter of target spot*
S_n = *smallest known diameter of target spot*
S_f = *greatest known diameter of target spot*
D_x = *distance to unknown target spot*
D_n = *distance to smaller known target spot*
D_f = *distance to greater known target spot*

Figure 1: How to read the optical diagrams

Technical Data

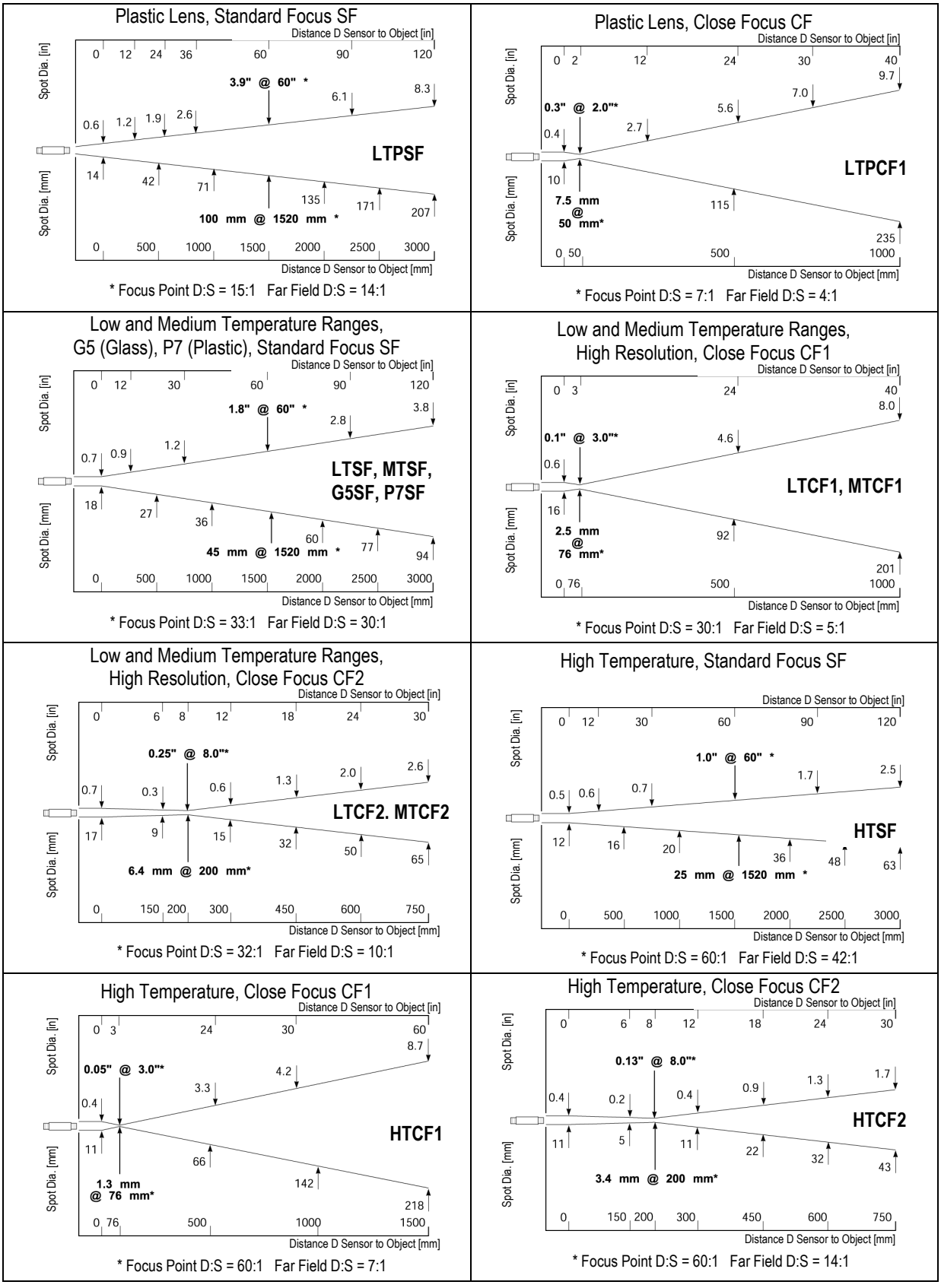

Plastic Lens, Standard Focus SF
Distance D Sensor to Object [in]
Spot Dia. [in]
0 12 24 36 60 90 120
3.9" @ 60" *
0.6 1.2 1.9 2.6 6.1 8.3
LTPSF
Spot Dia. [mm]
14 42 71 135 171 207
100 mm @ 1520 mm *
0 500 1000 1500 2000 2500 3000
Distance D Sensor to Object [mm]
* Focus Point D:S = 15:1 Far Field D:S = 14:1
Plastic Lens, Close Focus CF
Distance D Sensor to Object [in]
Spot Dia. [in]
0 2 12 24 30 40
0.3" @ 2.0"*
0.4 2.7 5.6 7.0 9.7
LTPCF1
Spot Dia. [mm]
10 115 235
7.5 mm @ 50 mm*
0 50 500 1000
Distance D Sensor to Object [mm]
* Focus Point D:S = 7:1 Far Field D:S = 4:1
Low and Medium Temperature Ranges,
G5 (Glass), P7 (Plastic), Standard Focus SF
Distance D Sensor to Object [in]
Spot Dia. [in]
0 12 30 60 90 120
1.8" @ 60" *
0.7 0.9 1.2 2.8 3.8
LTSF, MTSF,
G5SF, P7SF
Spot Dia. [mm]
18 27 36 60 77 94
45 mm @ 1520 mm *
0 500 1000 1500 2000 2500 3000
Distance D Sensor to Object [mm]
* Focus Point D:S = 33:1 Far Field D:S = 30:1
Low and Medium Temperature Ranges,
High Resolution, Close Focus CF1
Distance D Sensor to Object [in]
Spot Dia. [in]
0 3 24 40
0.1" @ 3.0"*
0.6 4.6 8.0
LTCF1, MTCF1
Spot Dia. [mm]
16 92 201
2.5 mm @ 76 mm*
0 76 500 1000
Distance D Sensor to Object [mm]
* Focus Point D:S = 30:1 Far Field D:S = 5:1
Low and Medium Temperature Ranges,
High Resolution, Close Focus CF2
Distance D Sensor to Object [in]
Spot Dia. [in]
0 6 8 12 18 24 30
0.25" @ 8.0"*
0.7 0.3 0.6 1.3 2.0 2.6
LTCF2. MTCF2
Spot Dia. [mm]
17 9 15 32 50 65
6.4 mm @ 200 mm*
0 150 200 300 450 600 750
Distance D Sensor to Object [mm]
* Focus Point D:S = 32:1 Far Field D:S = 10:1
High Temperature, Standard Focus SF
Distance D Sensor to Object [in]
Spot Dia. [in]
0 12 30 60 90 120
1.0" @ 60" *
0.5 0.6 0.7 1.7 2.5
HTSF
Spot Dia. [mm]
12 16 20 36 48 63
25 mm @ 1520 mm *
0 500 1000 1500 2000 2500 3000
Distance D Sensor to Object [mm]
* Focus Point D:S = 60:1 Far Field D:S = 42:1
High Temperature, Close Focus CF1
Distance D Sensor to Object [in]
Spot Dia. [in]
0 3 24 30 60
0.05" @ 3.0"*
0.4 3.3 4.2 8.7
HTCF1
Spot Dia. [mm]
11 66 142 218
1.3 mm @ 76 mm*
0 76 500 1000 1500
Distance D Sensor to Object [mm]
* Focus Point D:S = 60:1 Far Field D:S = 7:1
High Temperature, Close Focus CF2
Distance D Sensor to Object [in]
Spot Dia. [in]
0 6 8 12 18 24 30
0.13" @ 8.0"*
0.4 0.2 0.4 0.9 1.3 1.7
HTCF2
Spot Dia. [mm]
11 5 11 22 32 43
3.4 mm @ 200 mm*
0 150 200 300 450 600 750
Distance D Sensor to Object [mm]
* Focus Point D:S = 60:1 Far Field D:S = 14:1

Figure 2: Optical Diagrams

2.3 Scope of Delivery

All models are provided with:

- operator´s manual
- a fixed bracket
- mounting nut
- models have 4 to 20 mA output

3 Basics

3.1 Measurement of Infrared Temperature

Everything emits an amount of infrared radiation according to its surface temperature. The intensity of the infrared radiation changes according to the temperature of the object. Depending on the material and surface properties, the emitted radiation lies in a wavelength spectrum of approximately 1 to 20 µm. The intensity of the infrared radiation (”heat radiation”) is dependent on the material. For many substances this material-dependent constant is known. It is referred to as ”emissivity value”, see appendix see section 9.2 Typical Emissivity Values, page 41.
Infrared thermometers are optical-electronic sensors. These sensors are able to detect ”radiation of heat”. Infrared thermometers are made up of a lens, a spectral filter, a sensor, and an electronic signal processing unit. The task of the spectral filter is to select the wavelength spectrum of interest. The sensor converts the infrared radiation into an electrical parameter. The connected electronics generate electrical signals for further analysis. As the intensity of the emitted infrared radiation is dependent on the material, the required emissivity can be selected on the sensor.
The biggest advantage of the infrared thermometer is its ability to measure in the absence of contact. Consequently, surface temperatures of moving or hard to reach objects can easily be measured.

3.2 Distance and Spot Size

The desired spot size on the target will determine the maximum measurement distance and the necessary focus length of the optical module. To avoid erroneous readings the target spot size must contain the entire field of view of the sensor. Consequently, the sensor must be positioned so the field of view is the same as or smaller than the desired target size. For a list indicating the available focus models and their parameters see Figure 2: Optical Diagrams on page 10.

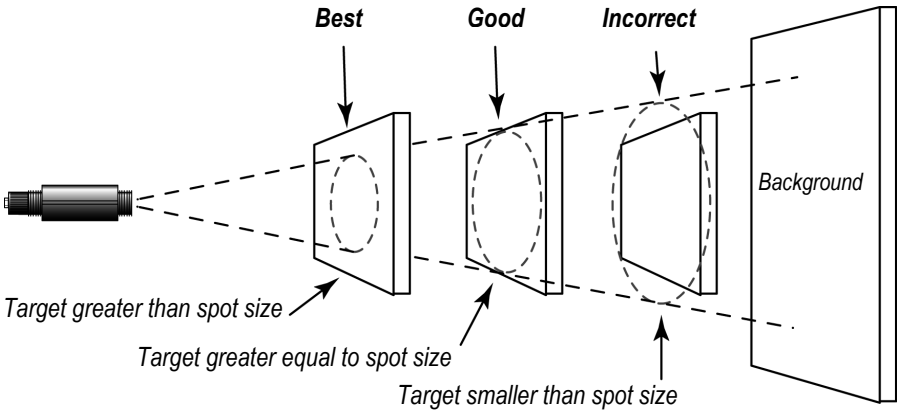


Figure 3: Proper Sensor Placement

3.3 Ambient Temperature

The sensing head is designed for measurements in ambient temperatures between 0°C and 70°C (32 to 160°F). In ambient conditions above 70°C (160°F), a water or air cooled housing is available to extend the operating range to 120°C (250°F) with air cooling and to 175°C (350°F) with water cooling. When using the water cooled housing, it is strongly recommended to use the supplied air purge collar to avoid condensation on the lens. In ambient conditions up to 315°C (600°F), the ThermoJacket housing should be used.

3.4 Atmospheric Quality

In order to prevent damage to the lens and erroneous readings, the lens should always be protected from dust, smoke, fumes, and other contaminants. For this purpose an air purge collar is available. You should only use oil free, clean “instrument“ air.

3.5 Electrical Interference

To minimize electrical or electromagnetic interference, follow these precautions:

- Mount the sensor as far away as possible from possible sources of interference such as motorized equipment producing large step load changes.
- Ensure a fully insulated installation of the sensor (Avoid ground loops!).
- Make sure the shield wire in the sensor cable is earth grounded at one location.

3.6 Emissivity of Target Object

Determine the emissivity of the target object as described in appendix 9.1 Determination of Emissivity on page 41. If emissivity is low, measured results could be falsified by interfering infrared radiation from background objects (such as heating systems, flames, fireclay bricks, etc. close beside or behind the target object). This type of problem can occur when measuring reflecting surfaces and very thin materials such as plastic films and glass.
This measuring error when measuring objects with low emissivity can be reduced to a minimum if particular care is taken during installation, and the sensing head is shielded from these reflecting radiation sources.

4 Installation

The infrared sensor provides a standard two-wire current loop output and has been designed for use in harsh industrial environments. The Smart model allows the remote programming of the temperature range, alarm values and other functions.

4.1 Wire Parameters for Current Loop

You should use shielded twisted pairs or multiple twisted pairs with a joint shield.

Line length

The maximum line length of one two-wire line per loop is dependent on the loop resistance (R), the capacitance per length unit (C), and the capacitance of the sensor C_S (5000 pF). It is calculated as follows:

$$l \approx \frac{65 \cdot 10^6}{R \cdot C} - \frac{C_S + 10000}{C}$$

l … in meter
R … in Ohm
C … in pF / m
C_S … in pF

For simplifying the formula use, the parameters must be provided as "naked values" (in the given dimension)!

Typical values for wire cross sections (copper)

- up to 250 m line length: 0.2 mm² cross section AWG24
- up to 650 m line length: 0.5 mm² cross section AWG20
- up to 1500 m multiple wire line lengths: 1.5 mm² cross section
- up to 3000 m single wire line lengths: 2.5 mm² cross section

4.2 Dimensions of Sensor

All sensors are supplied with a fixed bracket and mounting nut. Alternatively, the sensor may also be mounted using customer-supplied accessories. A pipe adapter and other accessories may also be used (see section 6.1 Overview on page 28).

All sensors and accessories are supplied with 1.5“ 20 UN 2 threads!

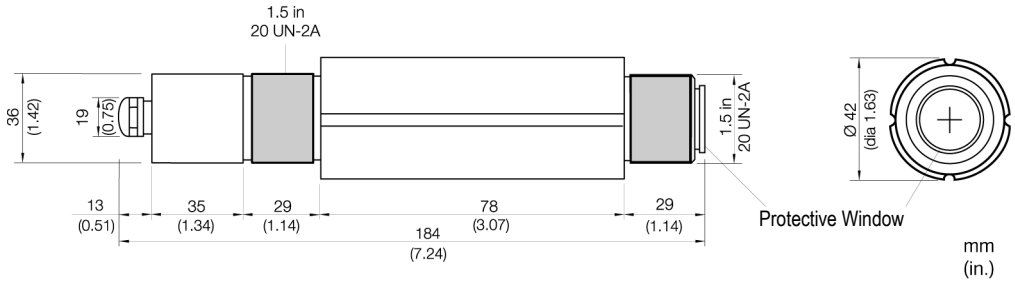


Figure 4: Dimensions of the Sensor

4.2.1 Fixed Brackets

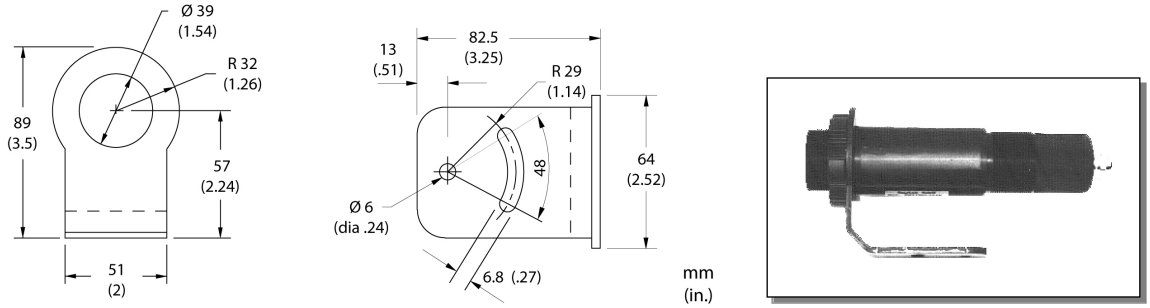


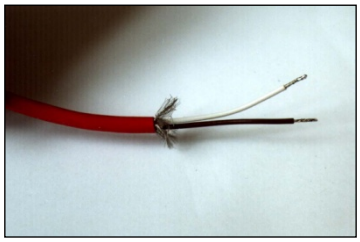
Figure 5: Fixed bracket XXXTXXACFB (left) with sensor delivered

4.3 Connecting the Signal Line

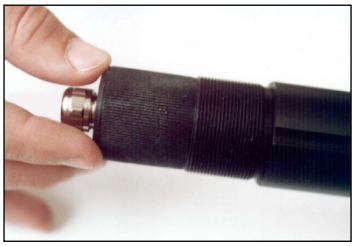
Before connecting the cable to the sensor (standard and Smart models) you should unscrew the cap from the back of the sensor. Proceed as follows:

Installation

1.) Prepare the cable, remove about 6cm (2.36 in) of the insulation. Shorten the shield to about 1cm (0.4 in). Tin-coat the connecting leads.

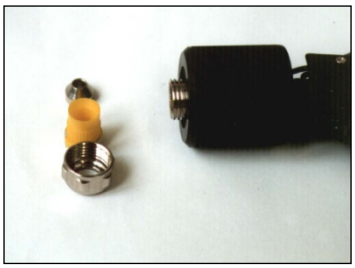


2.) Unscrew the end-cap until it can be pulled away from the sensor body.

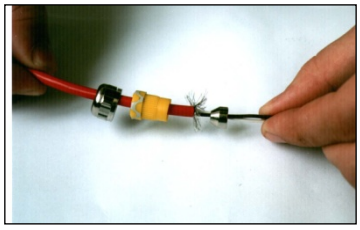


3.) Open the PG threaded cable gland.

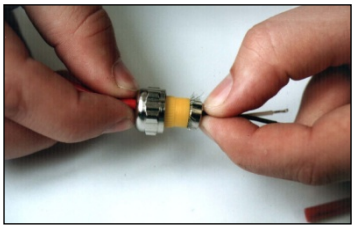
4.) The cable gland consists of a PG nut, a plastics part and a metal cone ring.



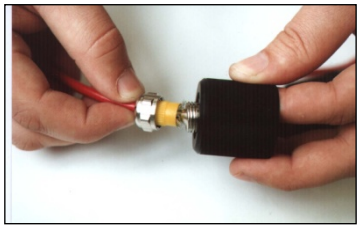
5.) Feed the prepared cable through the components of the cable gland.



6.) Make sure to have a proper contact between the braided shield and the metal cone ring.



7.) Place the PG screwed cable gland back into the outer cap. Tighten the PG nut firmly.



8.) Connect the signal wires to the screw terminals.

9.) Screw the end-cap firmly onto the sensor until it is tight (flush with the sensor body).

IMPORTANT: Neither the end-cap nor the cable gland should have any play after tightening.

The screwed cable gland described above is not a strain relief! Consequently, the cable must be clamped accordingly during the installation. The outside diameter of the connecting cables (round cable) should lie between 4 to 6 mm (about 0.2 inches). Note that it might be necessary to additionally seal the cable entry to allow IP65 with smaller cables!

4.4 Basic Model

The standard model is available for °C or °F. It provides a 2 pin screw-jumper terminal for connecting the 4 to 20 mA current loop. The polarity is indicated on the panel.
Above the screw-jumper terminal there are two rotary switches for emissivity setting. Emissivity is preset at the factory at 0.95 (see figure). The appendix lists typical emissivity values for common materials, see appendix see section 9.2 Typical Emissivity Values, page 41.

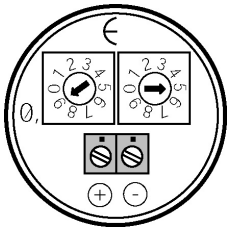


Figure 6: Back panel of basic model

4.4.1 Installation with a Controller

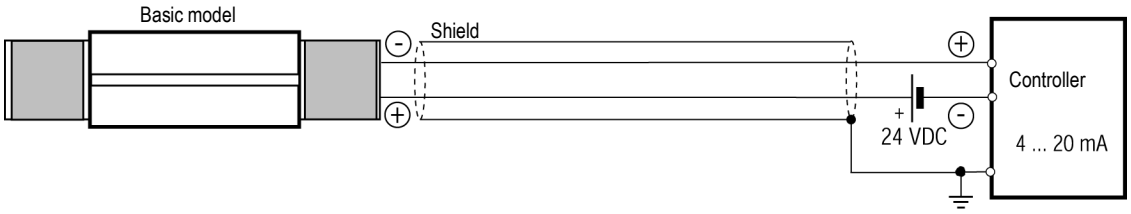


Figure 7: Typical installation of basic model

4.5 Smart Model

The Smart model has a 3 pin screw-jumper terminal for connecting the 4 to 20 mA current loop and the alarm output. The terminal assignment is marked on the panel. To allow clip leads from a HART adapter to attach directly to the sensor for setting sensor parameters, raise the removable terminal strip about 4 mm (0.2 inches) from the rear panel board and connect across the exposed (+) and (-) pins. For example, via line terminals, a lap-top with a HART adapter can be used for programming the sensor.

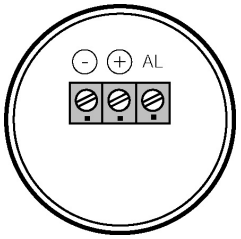


Figure 8: Back panel of basic model

4.5.1 HART Protocol

Originally, transmission of information was in one direction only, from sensing head to process control. The parameters monitored for the production of a product were not changed. In order to use the same technological equipment to manufacture a multitude of differing products, it must be possible to quickly alter many process parameters. This has an effect on the sensing head. Measuring range, accuracy and alarm values must be redefined. It would be extremely inconvenient if it were necessary to reprogram the sensing head at the unit every time. The HART protocol arose from this requirement. It allows the application of ”intelligent” sensors. The sensing heads can be programmed from the control room. This means that information is transmitted in two directions. The sensing head provides analog measured values to the control room via the 4 to 20 mA current loop. The sensing head can be reprogrammed from the control room by means of bi-directional transmission of digital signals. The superposition of analog and digital signals is described by the HART protocol. Sensors

which are programmable in this way are called SMART sensors. Apart from the Smart model, a HART/RS232 adapter is also available. This adapter allows programming of infrared sensing heads using a computer with an RS232 interface.

4.5.2 HART/RS232 Adapter

The adapter (XXXTXACRCK) allows both remote setting and signal processing of one or more sensors in a 4 to 20 mA current loop. A software suitable for a Windows® PC are supplied together with the adapter. The adapter has a 25-pin terminal connector for connecting to an RS232 interface. Screw terminals are provided for connecting the 4 to 20 mA current loop, terminal 4 (S_2) and terminal 5 (S_1).

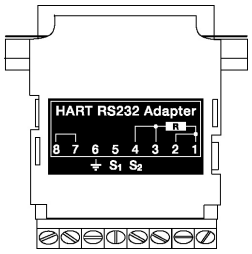


Figure 9: HART/RS232 adapter

Terminal 6 is connected internally to computer chassis ground!

4.5.3 Installation of Smart Model

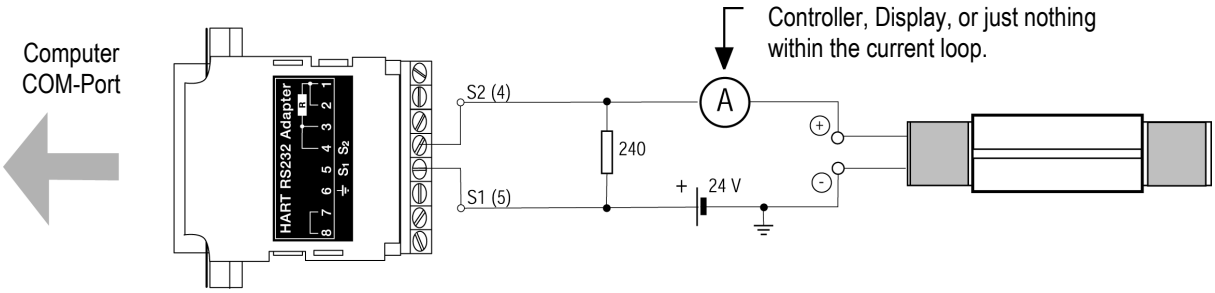


Figure 10: Typical installation of Smart model using the external resistor

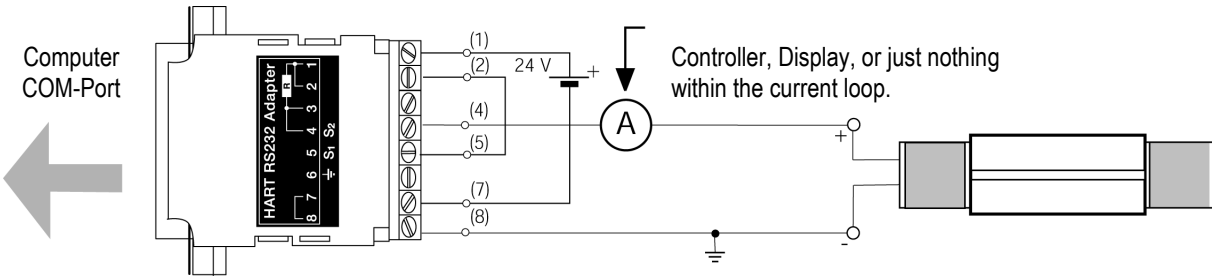


Figure 11: Typical installation of Smart model using the internal resistor

4.5.4 Address Assignment for Multiple Sensors

The sensing heads are factory-programmed with "Polling Address 0"!

When installing a number of sensors, note that each sensing head must first be assigned a separate polling (1 to 15). To do this, use the software supplied with the Smart model, and the HART/RS232 adapter:

- Install the software, see software manual.
- Connect the HART/RS232 adapter to the RS232 interface of your computer.
- Connect the Smart model which is to be programmed to the adapter. Use either the installation with the external resistor or the alternative with the internal resistor.
- For configuring the sensor, go to the <Sensor> <Sensor Setup> menu in the software.

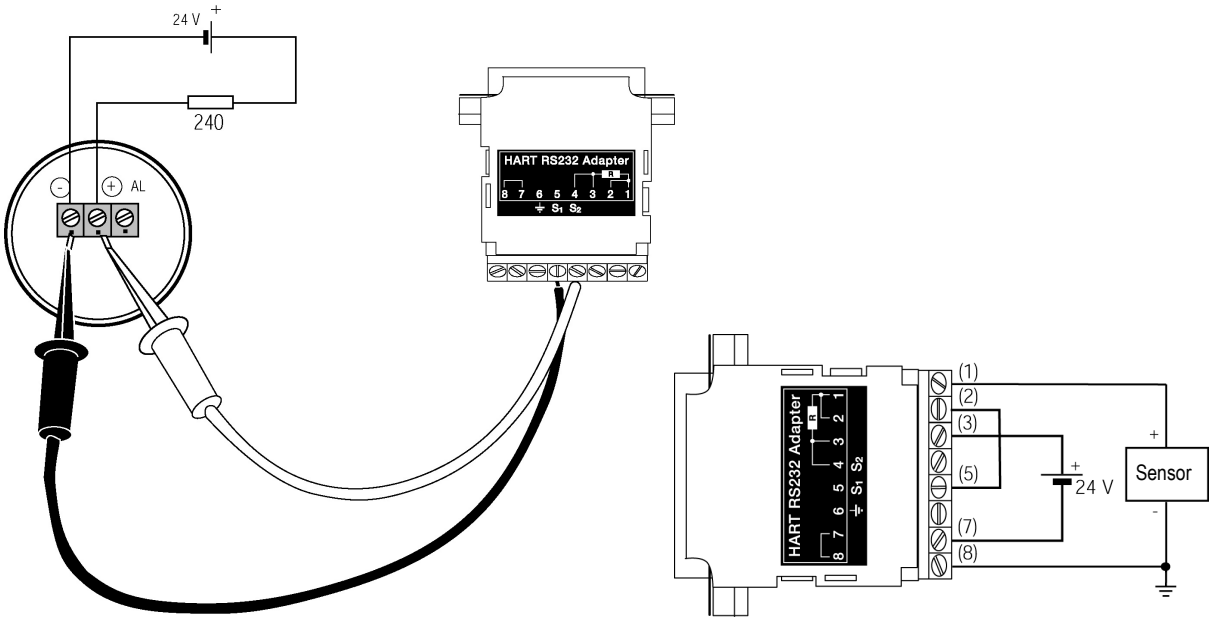
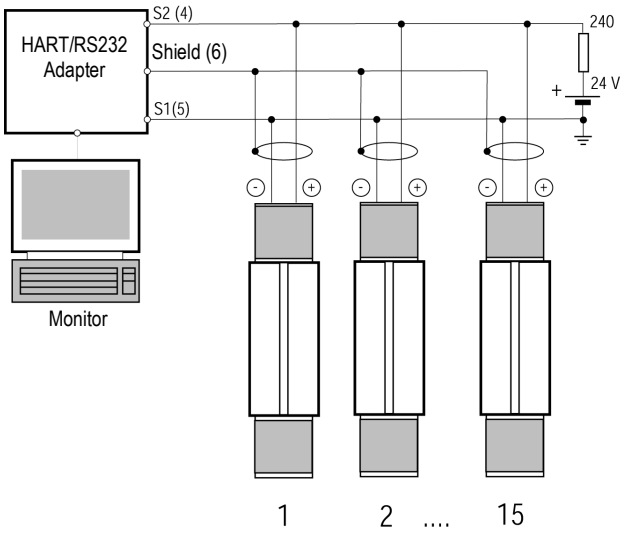


Figure 12: Address assignment with external (left) and internal (right) resistor

4.5.5 Installation of Multiple Sensors (digital, address mode)

- Maximum 15 sensors can be used. The polling address must always be >0.
- Communication is **purely digital**, no analog current output is provided
- Set each sensor failsafe mode to "minimum"



POWER SUPPLY		
Sensors	**Voltage [V]**	**Op. Current [mA]**
1	24	4
2	24	8
3	24	12
4	24	16
5	24	20
6	24	24
7	24	28
8	24	32
9	24	36
10	24	40
11	24	44
12	24	48
13	**28** !	52
14	**28**	56
15	**28**	60

Figure 13: All sensors in digital communication using the external resistor

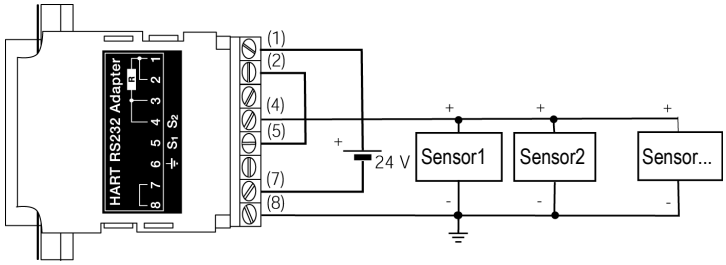


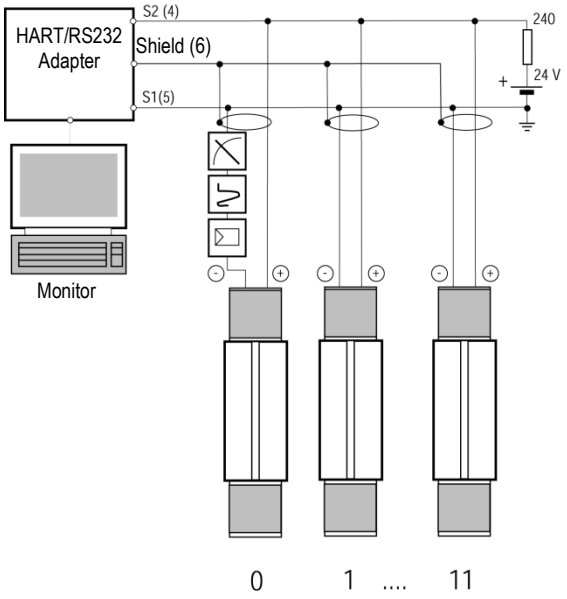
Figure 14: Multiple sensors using the internal resistor

The sensing heads are factory-programmed with "Polling Address 0"!

When installing a number of sensors, note that each sensing head must first be assigned a separate polling address (1 to 15), section 4.5.4 Address Assignment for Multiple Sensors on page 20).

4.5.6 Installation of Multiple Sensors (digital and analog, address mode)

- Maximum 12 sensors can be used.
- Analog and digital communication for the sensor with polling address 0.
- Communication for the remaining 11 sensors purely digital.



POWER SUPPLY		
Sensors	**Voltage [V]**	**Op. Current [mA]**
1	24	23
2	24	27
3	24	31
4	24	35
5	24	39
6	24	43
7	24	47
8	24	51
9	**28**	55
10	**28**	59
11	**28**	63
12	**28**	67

Figure 15: All sensors in digital communication, first sensor also with analog current output

The sensing heads are factory-programmed with "Polling Address 0"!

When installing a number of sensors, note that each sensing head must first be assigned a separate polling address (0 to 11), section 4.5.4 Address Assignment for Multiple Sensors on page 20).

4.5.7 Installation of Multiple Sensors (digital and analog, tag mode)

To run a sensor with analog current output, the sensor is to address with polling address 0. In case of having multiple sensors running with analog current output, the polling address can not be the criteria to distinguish between the sensors, because every sensor would be set to the same address. To avoid this, a sensor can be named by means of a so called **tag**. The tag will be stored within the units memory and can later be used to identify the sensor uniquely.

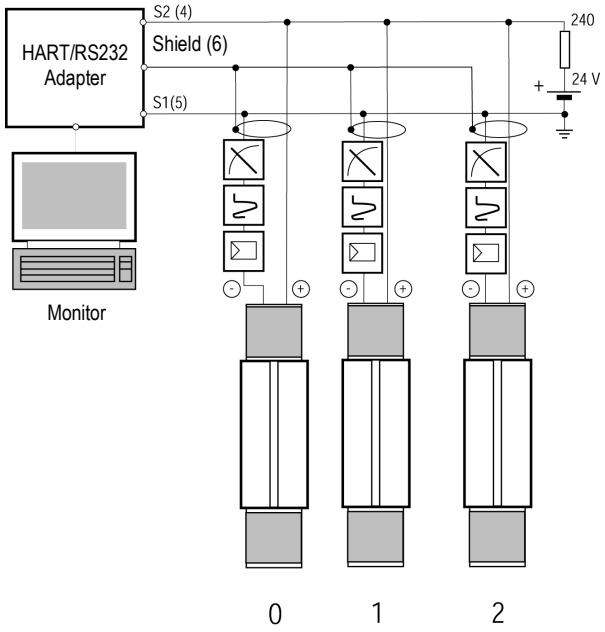


Figure 16: All sensors in digital communication and with analog current output

In case of having more than 3 units, please contact your local dealer for additional information for installing!

To prepare sensors for tag mode:

1. The sensing heads are factory-programmed with "Polling Address 0".
2. Start up the software with a single sensor (address mode).
3. Define a unique tag for the sensor, see the <Advanced Setup> in the menu <Sensor> <Sensor Setup>.
4. Exit the software.
5. Repeat steps 2 to 4 for every additional sensor.
6. Start up the software with multiple sensors, select <Define Scan List>, input the tags for all requested sensors.

4.5.8 Alarm Output

The alarm output of the Smart model is not electrically isolated. The maximum current carrying capacity is 150 mA. Use the circuit diagram. The LED is operated with 10 mA and could be used as an indicator, or as an optocoupler. The alarm current does not influence the signal current (4 to 20 mA current loop).

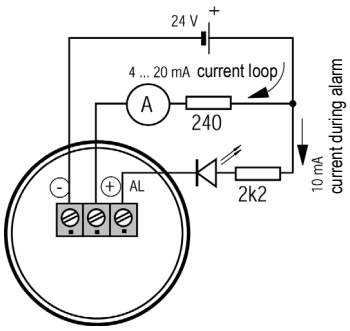


Figure 17: Using the alarm output

5 Options

A full range of options for various applications and environments are available. Options are factory-installed and must be specified at the time of placing the order:

- °C or °F (basic model only)
- Air/Water cooled housing (Option: …W), includes air purge
- Intrinsically-safe rating
  - …IS4 for TXS models
  - …IS4W for TXS models with Air/Water-Cooled Housing
  - …IS5 for TXS models in stainless steel
  - …IS5W for TXS models in stainless steel and Air/Water-Cooled Housing
- ISO Calibration Certificate, based on national standards (e.g. DAkkS) (XXXTXCERT)
- Sensor in stainless steel (…S)

5.1 Air/Water-Cooled Housing

The Air/Water-Cooled Housing option allows the sensor to be used in ambient temperatures up to 120°C (250°F) with air-cooling, and 175°C (350°F) with water-cooling. The cooling media should be connected using 1/8" NPT stainless steel fittings. Air flow should be 1.4 to 2.5 l/sec at 25°C (77°F). Water flow should be approximately 1.0 to 2.0 l/min (water temperature between 10 and 27°C (50 to 80.6°F). Chilled water below 10°C (50°F) is not recommended, see section 5.1.2 Avoidance of Condensation on page 25.

The Air/Water-Cooled Housing is also available in stainless steel (…S).

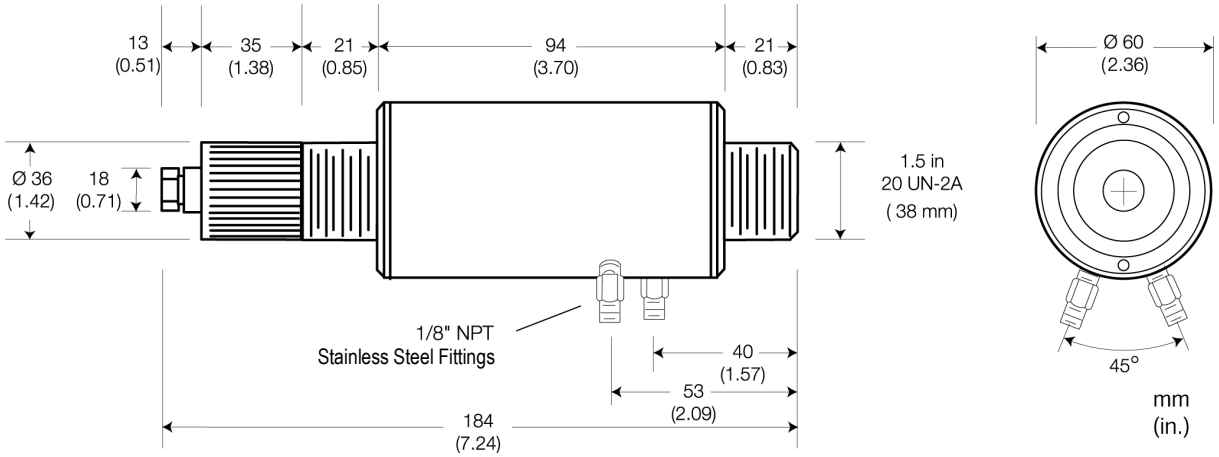
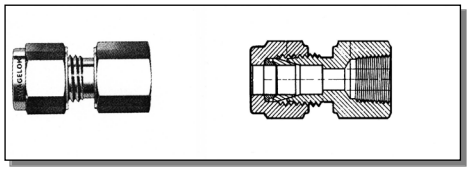


Figure 18: Sensor with Air/Water-Cooled Housing

5.1.1 Connecting

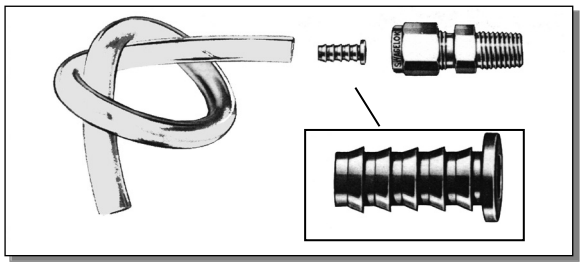
As a standard the cooled housing is supplied with fittings and non-metric 1/8" NPT threads. If you intend to supply the cooling media through pipes or hoses, consider the following information.

- Thread Adapter - metric pipe to NPT inside thread
- Thread Adapter - inch-type pipe to NPT inside thread



Inner Thread NPT (in.)	Pipe Outer Ø
1/8	4 mm (0.16 in)
1/8	6 mm (0.24 in)
1/8	8 mm (0.31 in)
Inner Thread NPT (in.)	**DIN-ISO-Outer Thread**
1/8	4 mm (0.16 in)

- Supporting tube for PVC or Tygon hoses



Tuber Outer Ø	Tube Inner Ø
6 mm	4 mm
8 mm	6 mm

5.1.2 Avoidance of Condensation

If environmental condition makes water cooling necessary, it is strictly recommended to check whether condensation will be a real problem or not.
Water cooling also causes a cooling of the air in the inner part of the device. Thereby the capability of the air to store water decreases. The relative humidity increases and can reach 100% very quickly. In case of a further cooling, the surplus water steam will come out as water (condensation). The water will condense on the lenses and the electronics resulting in possible damage to the sensor. Condensation can even happen on an IP65 sealed housing.

There is no warranty repair possible in case of condensed water within the housing!

To avoid condensation, the temperature of the cooling media and the flow rate have to ensure a **minimum** device temperature. The minimum device temperature depends on the ambient temperature and the relative humidity, please consider the following table.

Relative Humidity [%]

Ambient Temperature [°C/°F]	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32
5/ 41	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41
10/ 50	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	5/ 41	5/ 41	5/ 41	10/ 50
15/ 59	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	5/ 41	5/ 41	10/ 50	10/ 50	10/ 50	10/ 50	10/ 50	15/ 59
20/ 68	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	5/ 41	10/ 50	10/ 50	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	15/ 59	15/ 59	20/ 68
25/ 77	0/ 32	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	10/ 50	10/ 50	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	20/ 68	20/ 68	25/ 77
30/ 86	0/ 32	0/ 32	0/ 32	5/ 41	5/ 41	10/ 50	10/ 50	15/ 59	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	25/ 77	30/ 86
35/ 95	0/ 32	0/ 32	5/ 41	10/ 50	10/ 50	15/ 59	15/ 59	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	30/ 86	30/ 86	35/ 95
40/ 104	0/ 32	5/ 41	10/ 50	10/ 50	15/ 59	20/ 68	20/ 68	20/ 68	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	35/ 95	40/ 104
45/ 113	0/ 32	10/ 50	15/ 59	15/ 59	20/ 68	25/ 77	25/ 77	25/ 77	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	35/ 95	40/ 104	40/ 104	40/ 104	40/ 104	45/ 113
50/ 122	5/ 41	10/ 50	15/ 59	20/ 68	25/ 77	25/ 77	30/ 86	30/ 86	35/ 95	35/ 95	35/ 95	40/ 104	40/ 104	40/ 104	45/ 113	45/ 113	45/ 113	45/ 113	50/ 122
60/ 140	15/ 59	20/ 68	25/ 77	30/ 86	30/ 86	35/ 95	40/ 104	40/ 104	40/ 104	45/ 113	45/ 113	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	60/ 140
70/ 158	20/ 68	25/ 77	35/ 95	35/ 95	40/ 104	45/ 113	45/ 113	50/ 122	50/ 122	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140	70/ 158
80/ 176	25/ 77	35/ 95	40/ 104	45/ 113	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140	60/ 140	60/ 140	70/ 158	70/ 158	70/ 158	70/ 158	70/ 158	70/ 158	80/ 176
90/ 194	35/ 95	40/ 104	50/ 122	50/ 122	50/ 122	60/ 140	60/ 140	60/ 140	70/ 158	70/ 158	70/ 158	70/ 158	80/ 176	80/ 176	80/ 176	80/ 176	80/ 176	80/ 176	90/ 194
100/ 212	40/ 104	50/ 122	50/ 122	60/ 140	60/ 140	70/ 158	70/ 158	70/ 158	80/ 176	80/ 176	80/ 176	80/ 176	80/ 176	90/ 194	90/ 194	90/ 194	90/ 194	90/ 194	100/ 212

Tab. 1: Minimum device temperatures [°C/°F]

Example:

Ambient temperature = 50 °C
Relative humidity = 40 %
Minimum device temperature = 30 °C

The use of lower temperatures is at your own risk!

Temperatures higher than 60°C / 140°F are not recommended due to the temperature limitation of the device.

5.2 ATEX Intrinsic Safety

The Smart unit is available with Intrinsic Safety rated as:

II 2G Ex ib IIC T4 Gb for -20°C < $T_{Ambient}$ < 70°C (-4°F < $T_{Ambient}$ < 158°F)

II 2D Ex ibD IIIC T135°C Db for -20°C < $T_{Ambient}$ < 70°C (-4°F < $T_{Ambient}$ < 158°F)

The required power supply barrier for the unit must be ordered separately.
This intrinsically safe unit is available with a water cooled housing. The water cooled housing can provide a cooler, more stable operating environment for the electronics but does not allow for approved IS operation when external ambient conditions are above 70°C (158°F).
The recommended power supply barrier for the unit consists, in its simplest form, of two parts from the CONTRANS I series, manufactured by ABB Automation (formerly Hartmann & Braun):

- XXXAOIS2 – Intrinsically Safe isolating Driver, Part # V17151-620
- Din Rail mounted Sockets:

  XXXAOIS1 – socket for one driver, with integrated power supply for input voltages of 95 to 253 VAC (V17111-130)

  XXXAOIS6 – socket for one driver, with integrated power supply for input voltages of 19 to 33 VDC (V17111-120)

  XXXAOIS3 – socket for up to eight drivers (V17111-251)

  XXXAOIS4 – socket for up to 16 drivers (V17111-351)

The CONTRANS I interface modules are a series of driver modules, power supplies, and backplanes, all of which can be intermixed to provide the best solution for a specific application. The recommended solution, consisting of a single intrinsically safe isolating module and a single power supply socket, is only one of several combinations possible.

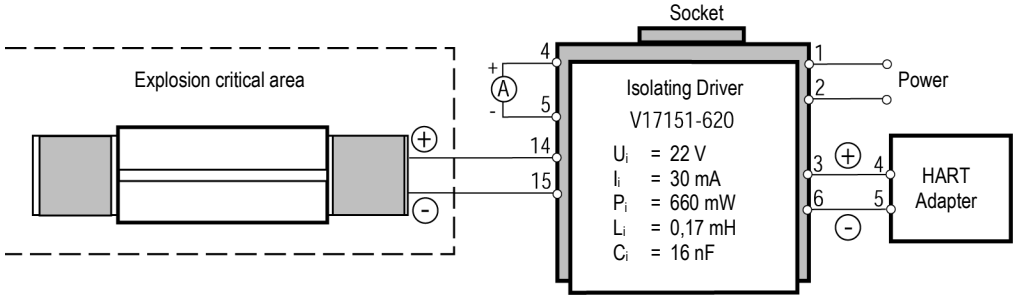


Figure 19: Intrinsic Safety Installation (example)

Units with Intrinsic Safety (IS) rating are also available made from stainless steel.

Please also consider section 9.4 ATEX Certificate of Conformity, page 46.

6 Accessories

6.1 Overview

For all models:

• Mounting Nut	XXXTXXACMN
• Fixed Mounting Bracket	XXXTXXACFB
• Adjustable Bracket	XXXTXXACAB
• Air Purge Collar	XXXTXXACAP
• Right Angle Mirror	XXXTXXACRA
• Sighting Viewer	XXXTXXACSV
• Pipe Adapter	XXXTXXACPA
• Pipe Adapter	XXXTXXAPA
• ThermoJacket Housing	RAYTXXTJ3M
• Industrial Power Supply	XXXSYSPS
• Protective Window for lens protection	
• Panel Mount Display	RAYGPC/RAYGPCM

For Smart model:

• PC communications software, HART/RS232 Adapter	XXXTXACRCK
• USB/RS232 Adapter	XXXUSB485S

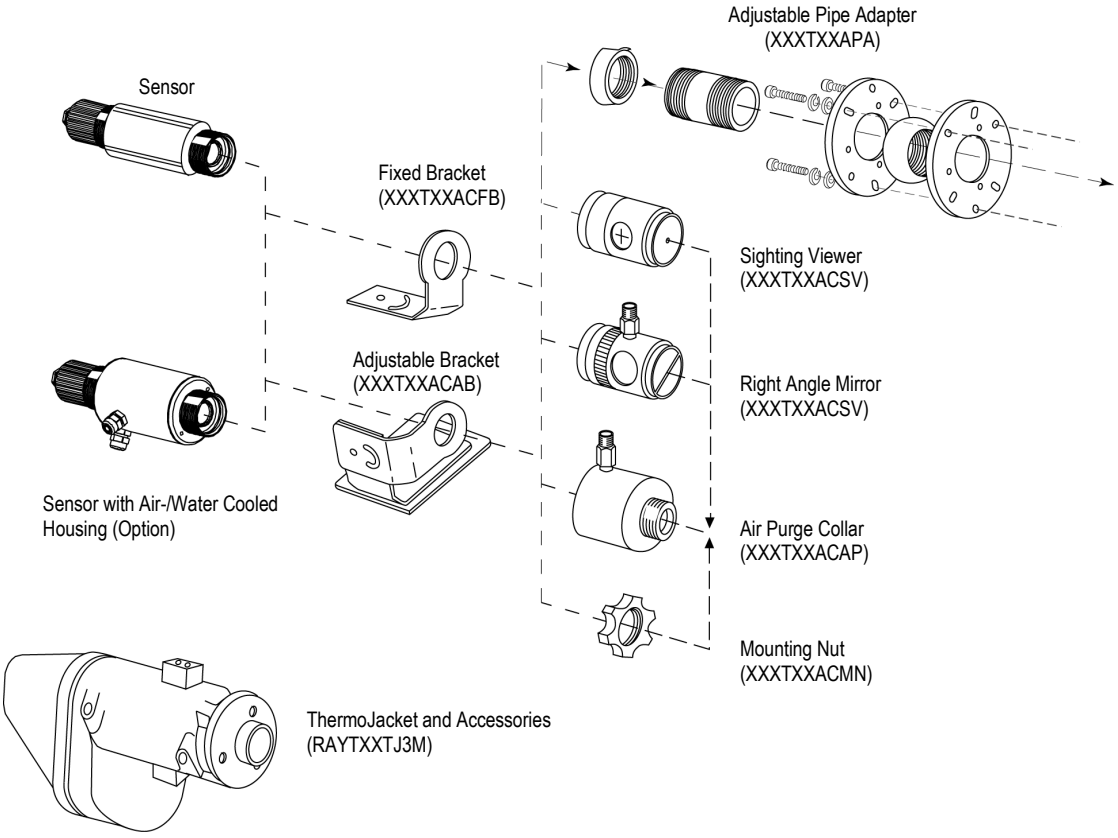


Figure 20: Overview to the available accessories

6.2 Adjustable Bracket

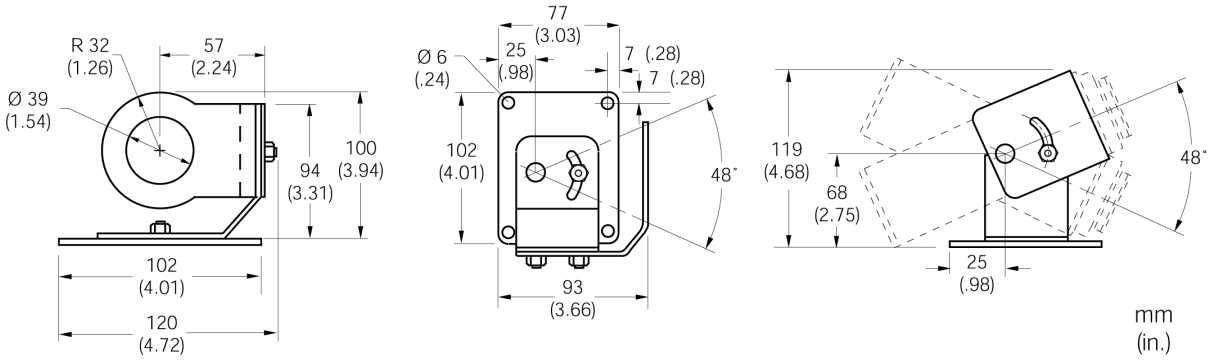


Figure 21: Adjustable Bracket (XXXTXXACAB)

6.3 Air Purge Collar

The Air Purge Collar (XXXTXXACAP) is used to keep dust, moisture, airborne particles, and vapors away from the lens. It can be mounted before or after the bracket. The air flow is passed through 1/8" NPT stainless steel fitting onto the front aperture. Air flow should be a maximum of 0.5 to 1.5 l/sec. Clean, oil free air is recommended.

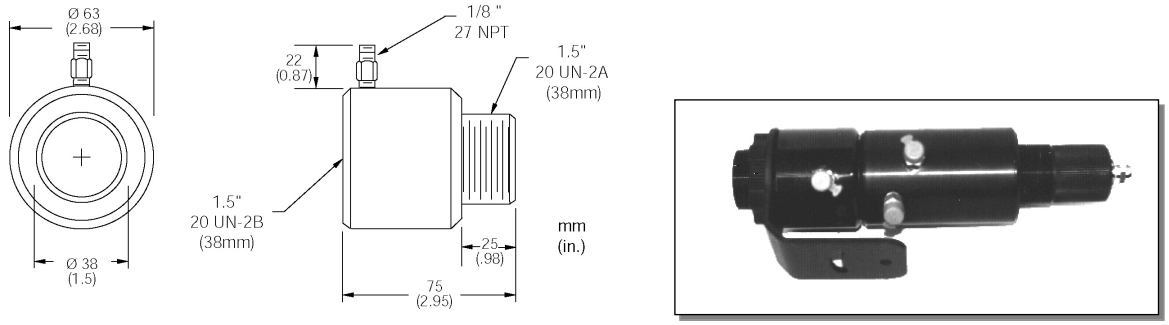


Figure 22: Dimension of Air Purge Collar (left), Sensor with Air Purge Collar (right)

6.4 Right Angle Mirror

The Right Angle Mirror (XXXTXXACRA) is used to turn the field of view by 90° against the sensor axis. It is recommended when space limitations or excessive radiation do not allow to directly align the sensor to the target. The mirror must be installed after the bracket and after the Air Purge Collar and screwed in fully. In dusty or contaminated environments, air purging is required to keep the mirror surface clean.

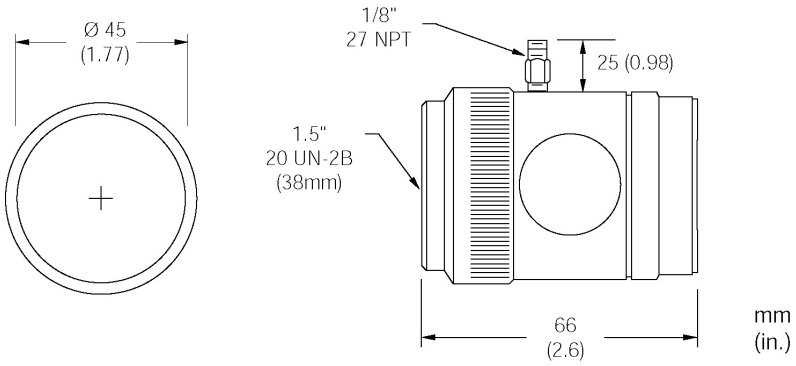


Figure 23: Right Angle Mirror

When using the Right Angle Mirror, adjust the emissivity settings downward by 5%. For example, for an object with an emissivity of 0.65, you adjust the value down to 0.62. This correction accounts for energy losses in the mirror!

6.5 Sighting Viewer

The Sighting Viewer (XXXTXXACSV) is used to aid in the alignment of the standard sensor. It is used when the object is small and far from the sensor as well as when it is difficult to obtain a direct in-line sighting. It can be used both with and without the Air Purge Collar, but not with the Right Angle Mirror. First secure the sensor to the bracket using the mounting nut or the Air Purge Collar. Next screw on the Sighting Viewer Tool fully. Now, position and secure the bracket. When the alignment is complete, do not forget to remove the Sighting Viewer Tool.

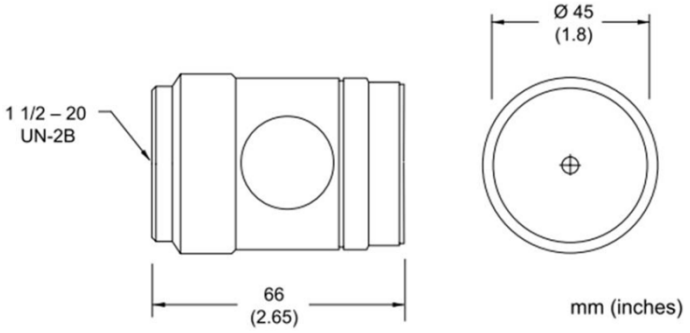


Figure 24: Sighting Viewer

6.6 Pipe Adapter

The adjustable pipe adapter (XXXTXXACPA) is available to connect a sighting tube or conduit to a sensor with or without water/air cooled housing.

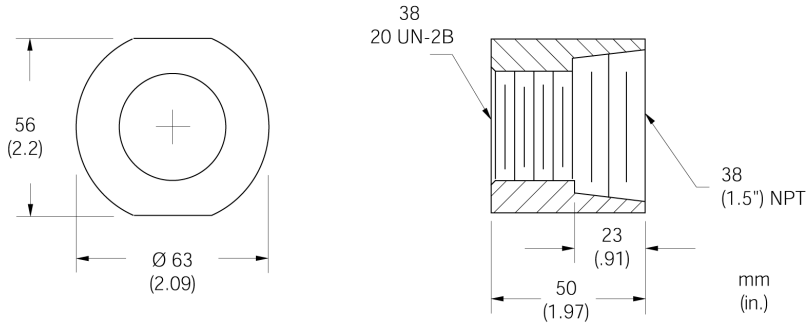


Figure 25: Pipe Adapter

6.7 Adjustable Pipe Adapter

The adjustable pipe adapter accessory (XXXTXXAPA) can be permanently placed on a surface and aimed in any direction within a 45° radius. The accessory kit includes two mounting flanges, a circular pipe adapter, a 2" pipe nipple, a mounting flange for sighting tube, and all necessary bolts and washers.

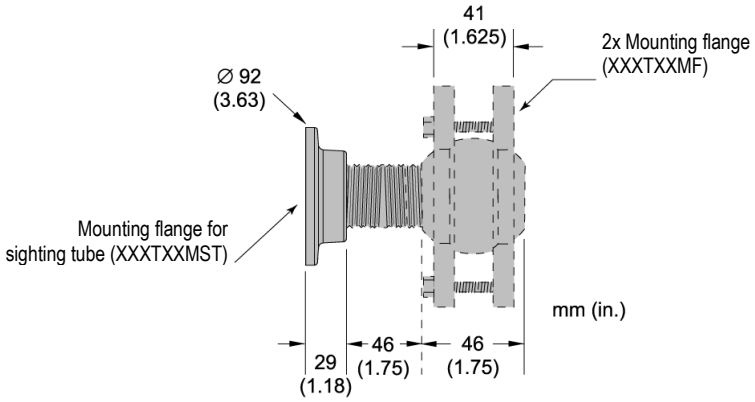


Figure 26: Adjustable Pipe Adapter

6.8 ThermoJacket

The ThermoJacket® allows use of the sensor in ambient temperatures up to 315°C (600°F). The rugged cast aluminum housing completely encloses the sensor and provides water cooling as well as air purging. Sensing heads can easily be installed or removed with the ThermoJacket housing in its mounted position.

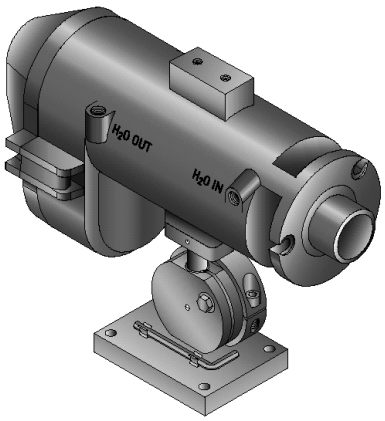


Figure 27: ThermoJacket (RAYTXXTJ3)

For more information see the ThermoJacket's manual.

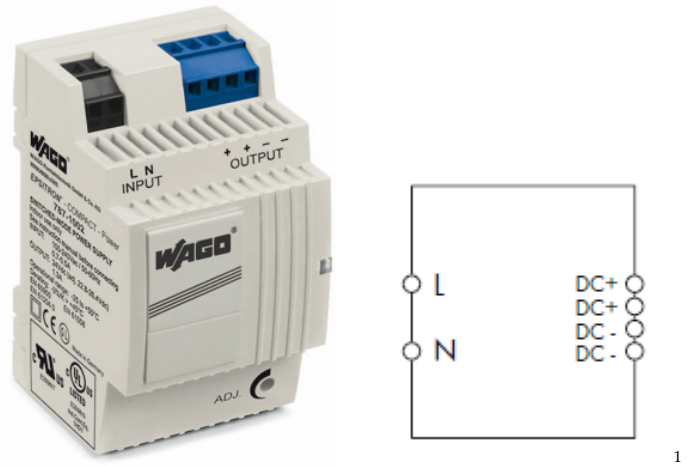
6.9 Industrial Power Supply

The DIN-rail mount industrial power supply delivers isolated dc power and provides short circuit and overload protection.

To prevent electrical shocks, the power supply must be used in protected environments (cabinets)!

Technical data:

Protection class	prepared for class II equipment
Environmental protection	IP20
Operating temperature range	-25°C to 55°C (-13°F to 131°F)
AC Input	100 – 240 VAC 44/66 Hz
DC Output	24 VDC / 1.3 A
Cross sections	input/output
	0.08 to 2.5 mm² (AWG 28 to 12)



[1]

Figure 28: Industrial Power Supply (XXXSYSPS)

[1] Copyright Wago®

6.10 Protective Window

Protective windows can be used to protect the sensor's optic against dust and other contaminations. For sensors with plastic lenses the use of a protective window combined with the air purge is strongly recommended.
The following table provides an overview of the available protective windows recommended for a LT, MT, HT, G5 and P7 model. All protective windows are also available in stainless steel (…S).

Order number	Model	Designation	Material	
XXXTXACTWL	LT	none	Amtir	0.65 ±0.05
XXXTXACTWLF1	LT	none (stainless steel)	Polyethylene foil (non-poisonous, non-fragile)	0.75 ±0.05
XXXTXACTWM	MT	4 red dots	Sapphire	0.88 ±0.05
XXXTXACTWH	HT	3 red dots	Glass	0.88 ±0.05
XXXTXACTWGP	G5, P7	2 red dots	Calcium Fluorid	0.93 ±0.05

Table 2: Protective Windows

For special requirements, please ask our Sales Department about our range of special protective windows.

Models delivered with mounted protective windows are preset as follows:

Basic model Basic model has no adjustable parameter for the transmissivity. The influence of transmissivity is reflected by a resulting emissivity value. E.g. transmissivity of protective window is 0.88, emissivity of measured object is 0.95, resulting emissivity value is set with the two rotary switches to 0.84 (0.88 * 0.95 = 0.84)

Smart model Transmissivity for the protective window is set in the software directly. The emissivity value is not changed.

Determination of transmissivity of an unknown protective window:
If transmissivity of the measuring screen is not indicated on the data sheet, you can also determine the transmissivity yourself. Please proceed as follows:

1. Measure the temperature of the target object with the sensing head, without using the protective window. Note correct setting of emissivity. With the basic model, emissivity is set with the two rotary switches. For the Smart model, the emissivity is entered in the software and the value for "Transmissivity" is specified as 1.00.
2. Insert the protective window in the sensing head.
3. If you use the **basic model** of the sensing head, adjust the emissivity until the same temperature is displayed, as was determined without the protective window.
   If the **smart model** is used, adjust the transmissivity in the software until the same temperature is displayed, as it was determined without the protective window.

For more information regarding the mounting of a protective window, see section 8.4 Replacing a Protective Window on page 39.

6.11 USB/RS232 Adapter

The USB/RS232 Adapter is one standard USB 2.0 to serial bridge that has one DB-9 RS232 male connector. The DB-9 pin serial port is configured as a DTE (data terminal equipment) device which is same as all PC COM ports. The industry DIN rail and panel mounting design enable user a fast and professional installation.

Technical Data

Power supply	5 VDC direct from USB port
Speed	max. 256 kBit/s
RS232	standard 9 pin DTE full-duplex
USB connector	type B (supplied with type A to type B cable)
Ambient Temperature	0 to 60°C (32 to 140°F), 10-90% relative humidity, non-condensing
Storage Temperature	-20 to 70°C (-4 to 158°F), 10-90% relative humidity, non-condensing
Dimensions (L x W x H)	151 x 75 x 26 mm (5.9 x 2.9 x 1 in)

Figure 29: USB/RS232 Converter (XXXUSB485S**)**

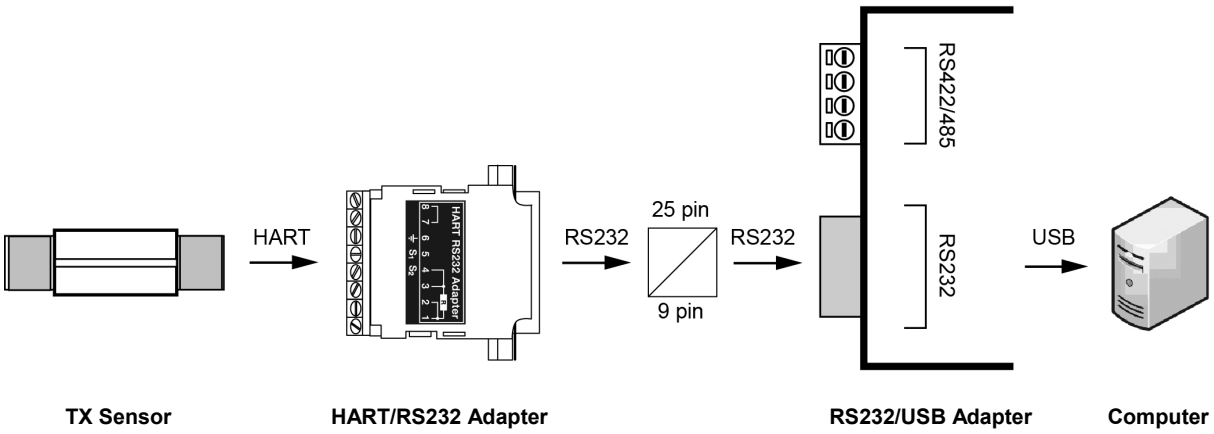


Figure 30: Principal bridging a TX sensor with HART communication via RS232 to USB communications

7 Software

7.1 Requirements

- PC running Windows 2000/XP/Vista/Win7 at minimum 64 MB RAM
- approx. 10 MB hard-disc memory for the program

7.2 Installation and Start

The following explains how to start and setup the software. Make sure any sensor or sensors are turned on before running the program. The Startup Wizard runs the first time you use the program. After the first saving your settings, the program starts at the Main screen.

Software Start

1. To install the software, choose the SETUP.EXE file on your data medium.
2. Double click the <DataTemp Multidrop> icon on your desktop to open the software. The software prompts you to choose to create a new file or open a saved file. Click the <Create a New File> button.
3. The software checks for a free COM port, this appears as pre-setting. Make sure the <**HART Protocol**> is selected on the screen.
4. Click <Continue> and follow instructions on the screen.
5. On the last screen click <Finish>.

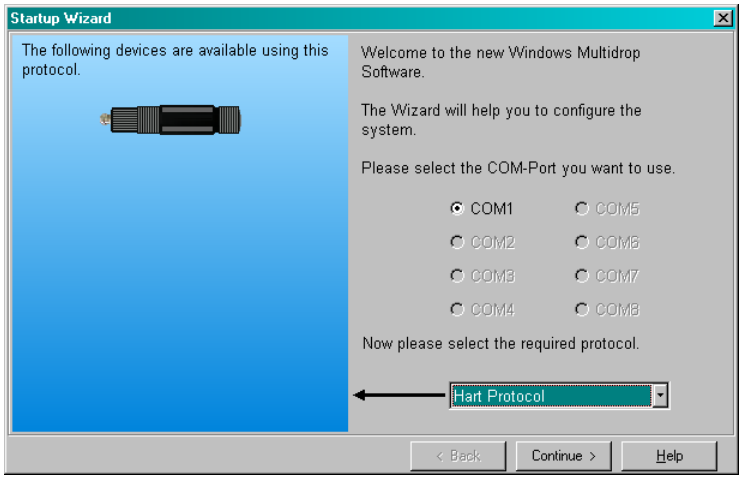


Figure 31: Setting the Software to <HART> Protocol

After communication with the devices (real or simulated) is established, a screen similar to the one below displays. This screen shows how many devices are attached as well as their identification numbers and types of devices. Check here to make sure all installed devices are connected properly.

Note: If you notice that not all devices were found, click on the <Back> button to return to the previous screen, then go check your sensor connections. After checking, click on the <Continue> button so the software rescans for connected devices.

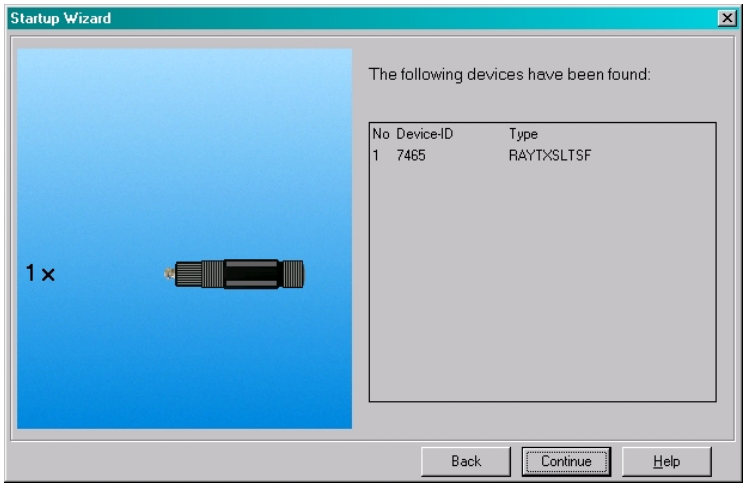


Figure 32: List of Found Devices

7.3 Sensor Setup

Selecting <Sensor Setup> from the <Setup> displays a list of attached sensors. When you select one, a screen similar to the following displays.
In the <Sensor Setup> screen, you may configure the settings for the signal processing (emissivity, ambient control, hold modes, fail safe mode), the output signals (alarms and relay), and the advanced setup (polling address, descriptions).

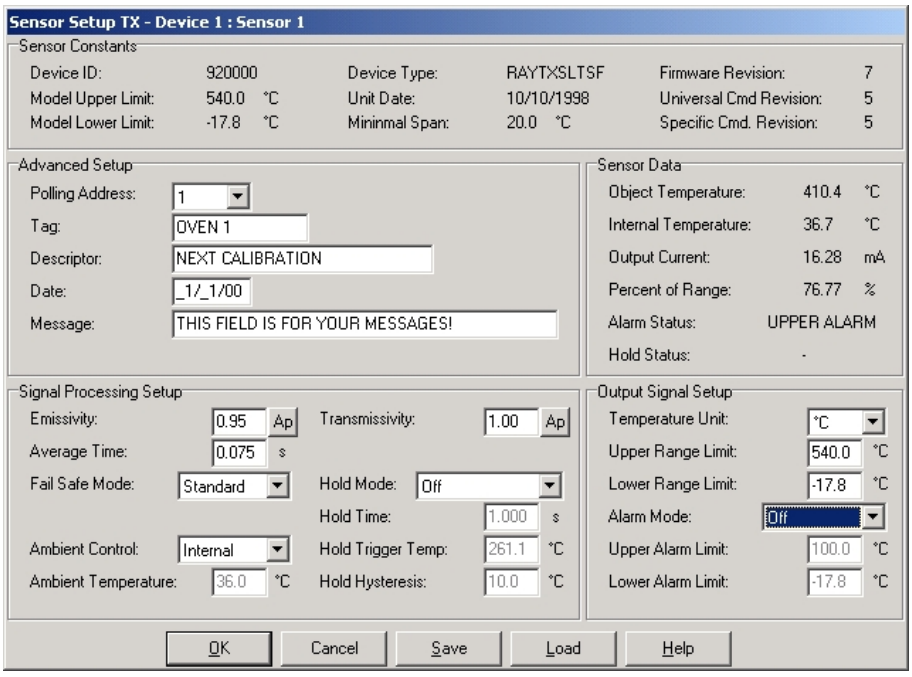


Figure 33: <Sensor Setup> Menu

See the DataTemp Multidrop software help for further instructions!

8 Maintenance

Our customer service representatives are always at your disposal for any questions you might have. This service includes any support regarding the proper application of your infrared measuring system, calibration or the solution to customer-specific solutions as well as repair.
In many cases your problems will be applications-specific and can possibly be solved over the telephone. So, if you need to return equipment to us, please contact our Service Department before doing so, see phone and fax numbers at the beginning of this document.

8.1 Troubleshooting Minor Problems

Symptom	Possible Cause	Solution
No Output	Cable Disconnected	Check Cable Connections
Erroneous Temperature	Faulty Sensor Cable	Verify Cable's Integrity
Erroneous Temperature	Field of View Obstructed	Remove the Obstruction
Erroneous Temperature	Lens Dirty	Clean the Lens
Erroneous Temperature	Wrong Emissivity Setting	Correct the Setting
Temperature Fluctuates	Wrong Signal Processing	Correct Peak, Valley, or Average Settings

Tab. 3: Troubleshooting

8.2 Automatic Error Indication

The automatic error indication (alarm output) shall warn the user and guarantee a secure output in the event of a system error. In the first place, however, its task is to switch the system off in case of a faulty setup or a defect in the sensing head or in the electronic circuits.

Please select the desired **Alarm Mode**, see <Advanced Setup> in the menu <Sensor> <Sensor Setup> of the software.

- Off — no alarm function
- Normally Open — open output within the alarm thresholds
- Normally Closed — closed output within the alarm thresholds
- Intern. Temp. n.c. — open, if internal sensor temperature is exceeded
- Intern. Temp. n.o. — closed if internal sensor temperature is exceeded

Current output:

Symptom	4 – 20 mA Output
Internal defect	21 mA
Target temperature under range	4 mA
Target temperature over range	20 mA

Never rely exclusively on the automatic error indication when monitoring critical heating processes. It is strongly recommended to take additional safety measures!

8.3 Cleaning the Lens

Care should be taken to keep the lens clean. Any foreign matter on the lens will affect the accuracy of the measurements. Be sure to take care when cleaning the lens. Please observe the following:

1. Blow off lose particles with clean air.
2. Gently brush off remaining particles with a soft camel hair brush.
3. To remove any more severe contamination use a clean, soft cloth dampened with distilled water. In any case, do not scratch the lens surface!

For finger prints or other grease, use any of the following:

- Denaturated alcohol
- Ethanol
- Kodak lens cleaner

Apply any of the above to the lens. Wipe gently with a clean, soft cloth until you see colors on the lens surface, then allow to air dry. Never wipe the surface dry, this may scratch the surface. If the lens is contaminated with silicones (e.g. from hand creams), clean it carefully using Hexane. Allow the lens to air dry.

Do not use any ammonia or any cleaners containing ammonia to clean the lens. This may result in permanent damage to the lens' surface!

8.4 Replacing a Protective Window

8.4.1 Models produced after May 1999

Attention! Beginning production date **May 1999**, the models contain a thread allowing an easier protective window exchange. (If you received your model together with this manual, your model was produced after May 1999.) If you own an older model, refer to the description given in section 8.4.2 Models produced before May 1999 on page 40.

Make sure to use the appropriate protective window for the spectral range of your sensor model, for more information see section 6.10 Protective Window on page 34.

The window material is placed in a metal ring with a thread with an inner rubber gasket. This rubber gasket hermetically seals the sensor against atmospheric contaminants.
Replace the protective window using the special tool supplied with the spare window. Put the tools nozzles into the wholes on the window's mounting ring. Now gently unscrew the protective window from its mount by turning to the left. Take care to screw in the new protective window as tight as possible, but do not over tighten!

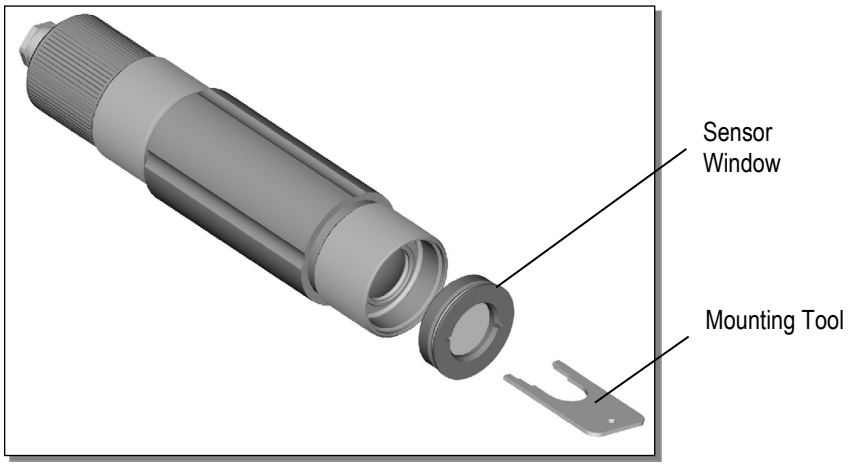


Figure 34: Replacing the Protective Window

8.4.2 Models produced before May 1999

Attention! If you own a model produced **before May 1999** and where the protective window looks similar to the one shown on the photographs below, refer to the following description.

Make sure to use the appropriate protective window for the spectral range of your sensor model, for more information see section 6.10 Protective Window on page 34.

The window material is placed in a metal ring which is enclosed with a rubber gasket. This rubber gasket keeps the protective window in the sensor. (Models produced later than May 1999 have a thread instead - check this, before you order spare parts!)
Replace the protective window using the plastic levers supplied with the spare window. Place the levers' blades beneath the projection of the protective window. Now gently lever the protective window from its mount.

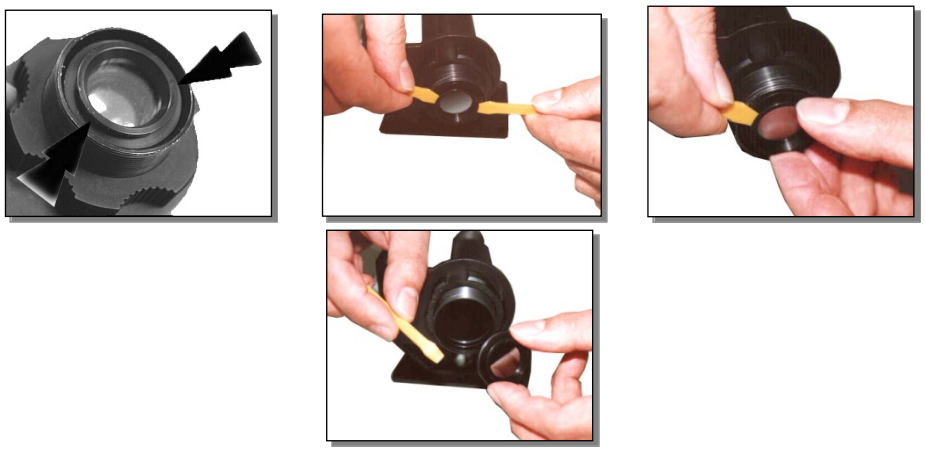


Figure 35: Replacing the Protective Window

9 Appendix

9.1 Determination of Emissivity

Emissivity is a measure of an object's ability to absorb and emit infrared energy. It can have a value between 0 and 1.0. For example a mirror has an emissivity of 0.1, while the so-called "Blackbody" reaches an emissivity value of 1.0. If a higher than actual emissivity value is set, the output will read low, provided the target temperature is above its ambient temperature. For example, if you have set 0.95 and the actual emissivity is 0.9, the temperature reading will be lower than the true temperature.
An object's emissivity can be determined by one of the following methods:

1. Determine the actual temperature of the material using an RTD (PT100), a thermocouple, or any other suitable method. Next, measure the object's temperature and adjust emissivity setting until the correct temperature value is reached. This is the correct emissivity for the measured material.
2. For relatively low temperatures (up to 260°C / 500°F) place a plastic sticker (e.g. XXXRPMACED) on the object to be measured. This sticker should be large enough to cover the target spot. Next, measure the sticker's temperature using an emissivity setting of 0.95. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.
3. If possible, apply flat black paint to a portion of the surface of the object. The emissivity of the paint must be above 0.98. Next, measure the temperature of the painted area using an emissivity setting of 0.98. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity until the same temperature is reached. This is the correct emissivity for the measured material.

To optimize surface temperature measurements, consider the following guidelines:

- Determine the object emissivity using the instrument which is also to be used for the measurements.
- Avoid reflections by shielding the object from surrounding temperature sources.
- For higher temperature objects use instruments with the shortest wavelength possible.
- For translucent materials such as plastic foils or glass, assure that the background is uniform and lower in temperature than the object.
- Mount instrument perpendicular to surface if possible. In all cases, do not exceed angles more than 30° from incidence.

9.2 Typical Emissivity Values

The following table provides a brief reference guide for determining emissivity and can be used when one of the above methods is not practical. Emissivity values shown in the table are only approximate, since several parameters may affect the emissivity of a material. These include the following:

1. Temperature
2. Angle of measurement
3. Geometry (plane, concave, convex)
4. Thickness
5. Surface quality (polished, rough, oxidized, sandblasted)
6. Spectral range of measurement
7. Transmissivity (e.g. thin films plastics)

Appendix

Material	Metals Emissivity			
	1 µm	**2.2 µm**	**5.1 µm**	**8 – 14 µm**
Aluminum				
Unoxidized	0.1-0.2	0.02-0.2	0.02-0.2	0.02-0.1
Oxidized	0.4	0.2-0.4	0.2-0.4	0.2-0.4
Alloy A3003, Oxidized		0.4	0.4	0.3
Roughened	0.2-0.8	0.2-0.6	0.1-0.4	0.1-0.3
Polished	0.1-0.2	0.02-0.1	0.02-0.1	0.02-0.1
Brass				
Polished	0.35	0.01-0.05	0.01-0.05	0.01-0.05
Burnished	0.65	0.4	0.3	0.3
Oxidized		0.6	0.5	0.5
Chromium	0.4	0.05-0.3	0.03-0.3	0.02-0.2
Copper				
Polished	0.05	0.03	0.03	0.03
Roughened	0.05-0.2	0.05-0.2	0.05-0.15	0.05-0.1
Oxidized	0.2-0.8	0.7-0.9	0.5-0.8	0.4-0.8
Gold	0.3	0.01-0.1	0.01-0.1	0.01-0.1
Haynes				
Alloy	0.5-0.9	0.6-0.9	0.3-0.8	0.3-0.8
Inconel				
Oxidized	0.4-0.9	0.6-0.9	0.6-0.9	0.7-0.95
Sandblasted	0.3-0.4	0.3-0.6	0.3-0.6	0.3-0.6
Electropolished	0.2-0.5	0.25	0.15	0.15
Iron				
Oxidized	0.7-0.9	0.7-0.9	0.6-0.9	0.5-0.9
Unoxidized	0.35	0.1-0.3	0.05-0.25	0.05-0.2
Rusted		0.6-0.9	0.5-0.8	0.5-0.7
Molten	0.35	0.4-0.6	—	—
Iron, Cast				
Oxidized	0.9	0.7-0.95	0.65-0.95	0.6-0.95
Unoxidized	0.35	0.3	0.25	0.2
Molten	0.35	0.3-0.4	0.2-0.3	0.2-0.3
Iron, Wrought				
Dull		0.95	0.9	0.9

Tab. 4: Typical Emissivity Values

Material	Metals Emissivity			
	1 µm	**2.2 µm**	**5.1 µm**	**8 – 14 µm**
Lead				
Polished		0.05-0.2	0.05-0.2	0.05-0.1
Rough		0.5	0.4	0.4
Oxidized		0.3-0.7	0.2-0.7	0.2-0.6
Magnesium	0.3-0.8	0.05-0.2	0.03-0.15	0.02-0.1
Mercury		0.05-0.15	0.05-0.15	0.05-0.15
Molybdenum				
Oxidized	0.5-0.9	0.4-0.9	0.3-0.7	0.2-0.6
Unoxidized	0.25-0.35	0.1-0.3	0.1-0.15	0.1
Monel (Ni-Cu)	0.3	0.2-0.6	0.1-0.5	0.1-0.14
Nickel				
Oxidized	0.8-0.9	0.4-0.7	0.3-0.6	0.2-0.5
Electrolytic	0.2-0.4	0.1-0.2	0.1-0.15	0.05-0.15
Platinum				
Black		0.95	0.9	0.9
Silver	0.04	0.02	0.02	0.02
Steel				
Cold-Rolled	0.8-0.9	—	0.8-0.9	0.7-0.9
Ground Sheet		0.6-0.7	0.5-0.7	0.4-0.6
Polished Sheet	0.35	0.2	0.1	0.1
Molten	0.35	0.25-0.4	0.1-0.2	—
Oxidized	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.9
Stainless	0.35	0.2-0.9	0.15-0.8	0.1-0.8
Tin (Unoxidized)	0.25	0.1-0.3	0.05	0.05
Titanium				
Polished	0.5-0.75	0.2-0.5	0.1-0.3	0.05-0.2
Oxidized		0.6-0.8	0.5-0.7	0.5-0.6
Tungsten		0.1-0.6	0.05-0.5	0.03
Polished		0.1-0.3	0.05-0.25	0.03-0.1
Zinc				
Oxidized	0.6	0.15	0.1	0.1
Polished	0.5	0.05	0.03	0.02

Tab. 5: Typical Emissivity Values

Appendix

Material	NON-METALS Emissivity			
	1 µm	**2.2 µm**	**5.1 µm**	**8 – 14 µm**
Asbestos	0.9	0.8	0.9	0.95
Asphalt		—	0.95	0.95
Basalt		—	0.7	0.7
Carbon				
Unoxidized		0.8-0.9	0.8-0.9	0.8-0.9
Graphite		0.8-0.9	0.7-0.9	0.7-0.8
Carborundum		0.95	0.9	0.9
Ceramic	0.4	0.8-0.95	0.8-0.95	0.95
Clay		0.8-0.95	0.85-0.95	0.95
Concrete	0.65	0.9	0.9	0.95
Cloth		—	0.95	0.95
Glass				
Plate		0.2	0.98	0.85
"Gob"		0.4-0.9	0.9	—
Gravel		—	0.95	0.95
Gypsum		—	0.4-0.97	0.8-0.95
Ice		—	—	0.98
Limestone		—	0.4-0.98	0.98
Paint (non-al.)		—	—	0.9-0.95
Paper (any color)		—	0.95	0.95
Plastic (opaque, over 20 mils)		—	0.95	0.95
Rubber		—	0.9	0.95
Sand		—	0.9	0.9
Snow		—	—	0.9
Soil		—	—	0.9-0.98
Water		—	—	0.93
Wood, Natural		—	0.9-0.95	0.9-0.95

Tab. 6: Typical Emissivity Values

9.3 Display Monitor

The Display Monitor GP (order number: RAYGPC/RAYGPCM) may be operated both with the standard and with the Smart model. The monitor allows Peak Hold, Valley Hold and Average and allows to adjust two setpoints for alarm- or control use. The display monitor requires a supply voltage of 110 VAC or 220 VAC. The monitor meets IP54 (IEC529, NEMA-12) requirements. The unit withstands ambient temperatures in between 0 to 50°C (32 to 120°F). The 1/8 DIN monitor provides a 4 to 20 mA signal input. The 4 digit LED display has a display resolution from 1°C (1°F). For more detailed information, please be referred to the GP manual.

Figure 36: Monitor GP

9.3.1 Installation with the Sensor

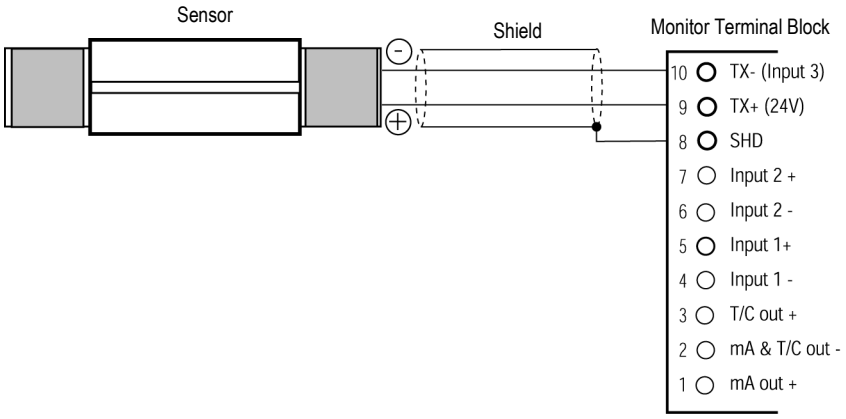


Figure 37: Sensor in analog communication, display with the monitor

The monitor can also be used to provide the power supply for a smart sensor in digital communication (pin 9: + 24 VDC, pin 10: ground). For activating the 4 – 20 mA current input, the monitor must be set to the device type **H005**, see the operating instructions for the monitor.
A possible installation is given in the figure below. For other installations see the figures in section 4.5 Smart Model on page 18.

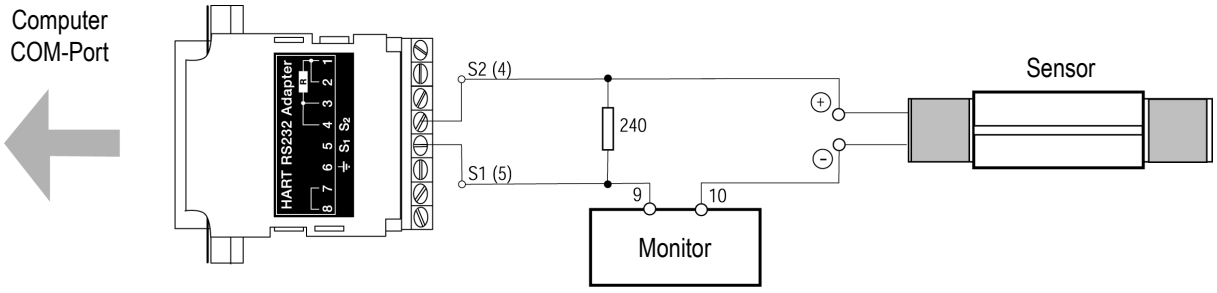


Figure 38: Sensor in digital communication, display and power with the monitor

9.4 ATEX Certificate of Conformity

BUREAU VERITAS

(1) EC-Type Examination Certificate

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres – **Directive 94/9/EC**

(3) EC Type Examination Certificate Number

EPS 12 ATEX 1 477 X

(4) Equipment: Infrarot – Temperaturmessgerät Thermalert TX

(5) Manufacturer: Raytek GmbH

(6) Address: Blankenburgerstrasse 135, 13127 Berlin

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) Bureau Veritas Consumer Products Services Germany GmbH, Notified Body No. 2004 in accordance with Article 9 of the Council Directive 94/9/EC of March 23rd 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II of the Directive. The examination and test results are recorded in the confidential report 12TH0291.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2009 **EN 60079-11:2007**

EN 61241-11:2006

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC Type Examination Certificate relates only to the design and the construction of the specified equipment in accordance with Directive 94/9/EC. Further requirements of this Directive apply to the manufacture and supply of this equipment.

(12) The marking of the equipment shall include the following:

II 2G Ex ib IIC T4 Gb

II 2D Ex ibD IIIC T135°C Db

Certification department of explosion protection

Türkheim, January 15, 2013

D. Zitzmann

Page 1 / 2

Certificates without signature are void. This certificate is allowed to be distributed only if not modified.
Extracts or modifications must be authorized by Bureau Veritas Consumer Products Services Germany GmbH.
This certificate is internally administrated under the following number: 12-207

(13) **Annexe**

(14) **EC Type Examination Certificate EPS 12 ATEX 1 477 x**

(15) Description of equipment:

The Thermalert TX is a stationary infrared temperature measuring device for the use in potential gas / dust explosive hazardous locations. Measurements are conducted via an infrared temperature sensor. For supply and output signal of 4-20mA, overlain by a HART-communication signal is used. The device is produced with different lens systems, housing coolant and different housing materials. There is no influence on the intrinsic safety due to the different designs. The housing of the device has IP65 protection.

Electrical data:

For connection to a certified intrinsic	Uo = 22 V
safe safety barrier or a certified intrinsic	Io= 30 mA
safe transducer with the following max.	Po = 660 mW
values:	rectangular characteristic curve

Co [nF]	73	100	140
Lo [µH]	1300	500	170

Inner capacity and inductivity:	Ci=16 nF between wires
	Ci = 4 nF against ground
	Li= 170 µH
The circuit is safe insulated grounded.	The existing inner inductivity and capacities have to be subtracted from the admissible values.

(16) Test report: 12TH0291

(17) Special conditions for safe use:

Admissible temperature conditions in gaseous and dust atmosphere: -20°C < Ta < + 70°C

(18) Essential health and safety requirements:

Met by standards.

Certification department of explosion protection — Türkheim, January 15, 2013

D. Zitzmann

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